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IMMATURE STAGES OF *PLECTROTARSUS GRAVENHORSTI* KOLENATI (TRICHOPTERA: PLECTROTARSIDAE) AND COMMENTS ON LIKELY FAMILY RELATIONSHIPS

By Arturs Neboiss

Department of Entomology, Museum of Victoria, 71 Victoria Crescent, Abbotsford, Victoria 3067, Australia.

Abstract: The larva, pupa and aspects of the biology of *Plectrotarsus gravenhorsti* Kolenati are described and the identity of the type specimen, an adult male, is ascertained. The larvae inhabit shallow, vegetation rich lakes, backwaters of small streams and swamplands in southeastern Australia and Tasmania.

Comparison of characters between several families supports a revision of trichopteran phylogeny to place Plectrotarsidae close to Oeconesidae and Lepidostomatidae, and to reinstate the family Kokiriidae.

The endemic Australian family Pleetrotarsidae *sensu* Mosely eontains five speeies in three genera. It has for many years been eonsiderd an enigmatie family, mainly due to the unusual mouth parts of the adult and the elusive nature of immatures. Wiggins (1981) argues that larvae are informative in reconstruction of phylogenies and the lack of deseribed larvae for Plectrotarsidae has been a problem. The first instar larvae were known to Riek (1970) although they remained undeseribed. Only recently have fully-developed larvae bcen assoeiated with a pupa and adult with eertainty.

The larva (Figs 9-12) shows elose similarities to two oeconesids, the New Zealand *Oeconesus maori* McLaehlan and Tasmanian *Tascuna ignota* Neboiss (Figs 13-15), but is greatly dissimilar from the larvae of the Australian and New Zealand Kokiriidae. The pupa of *P. gravenhorsti* closely resembles *O. maori* and some Sumatran and Javanese Lepidostomatidae (*Goerodes* sp.) in eharaeters on the terminal region of the abdomen, although their hook plates are substantially different.

These eonsiderations neeessitated re-examination of adults of *P. gravenhorsti*, but traeing the type speeimen proved rather diffieult. The speeies was described by Kolenati in 1848, with Western Australia given as its loeality ("Habitat in Australia occidentali", Kolenati 1848, p. 94). This species, however, is known to be restricted to southeastern Australia and Tasmania. The only West Australian speeies, *Plectrotarsus minor* Mosely, is distinct and could not be confused with *P. gravenhorsti*.

The type speeimen of *P. gravenhorsti* is in the Naturhistoriseh es Museum, Vienna, bears a handwritten loeality label "SW Australia" and an identifieation label "*gravenhorstii* det. Brauer" where the words "det. Brauer" are printed (Fig. 1). It has not been possible to establish the origin of this speeimen or to explain why it was labelled as eoming from southwestern Australia.

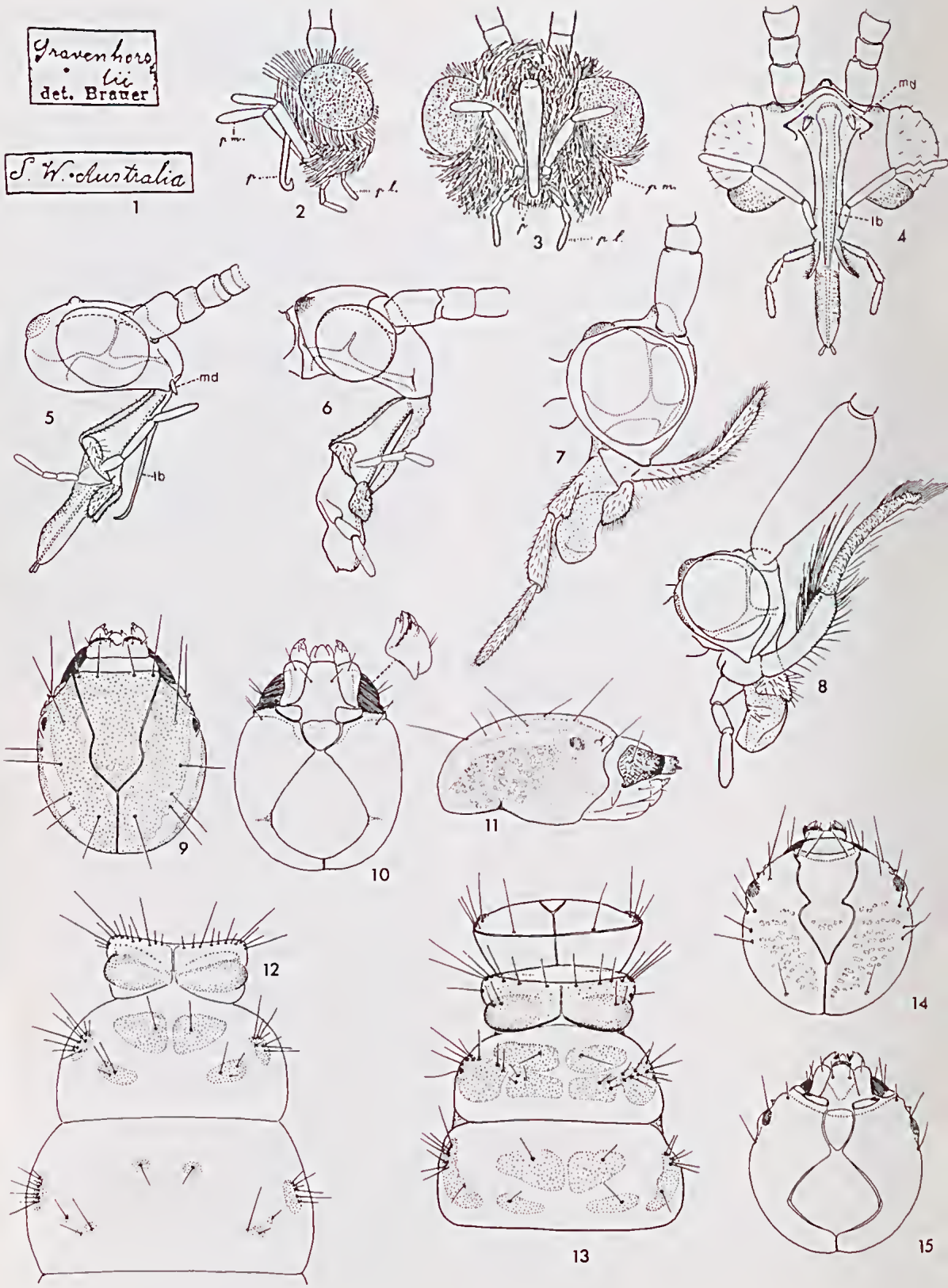
In his 1848 publieation, Kolenati described material from various sourees, including speeimens received from Gravenhorst. Presumably the type specimen was amongst these and henee the derivation of the name. The single speeimen of *P. gravenhorsti*, on which Kolenati based the deseription, appears to have remained in his possession until the collection was passed on to the Naturhistoriseh es Museum, Vienna, probably after his death in 1864.

A definite reference to this speeimen as the type appears in a publieation by Ulmer (1904) with the following remark on page 58 ". . . Herr J. Bischof (K. K. Naturhistorisches Hofmuseum in Wien) die Freundlichkeit gehabt, mir naeh der Type Kolenatis zwei Abbildungen des Kopfes anzufertigen . . ." (Mr. J. Bisehof very kindly prepared two figures of the head from Kolenati's type). The figures illustrate the lateral and ventral views of the head and are here reproduced (Figs 2, 3). The specimen agrees in every detail with the figures and leaves no doubt of its identity. Aecordingly, a holotype label is now attaehed to this speeimen.

In reeent phylogenetie analyses of the order Triehoptera, Weaver (1984) and Weaver and Morse (1986) removed Pleetrotarsidae from Ross's (1967) "limnephilid braneh". Ross had grouped Pleetrotarsidae together with Lepidostomatidae, Limnephilidae, Goeridae and others, whereas Weaver and Morse assigned it to a eluster as a sister group of the Philorheithridae under the superfamily Leptoeeroidea, infra-order Brevitentoria, eharaeterised by atrophieation of dorsal tentorial braneh in adults. Kokiriidae was regarded as a junior synonym of Plectrotarsidae by Weaver (1984) although no justification was given for the ehange. Detailed examination of the adult head shows the tentorium in *Plectrotarsus gravenhorsti* is eomplete (Fig. 5), whereas in Kokiriidae the dorsal braneh is ineomplete (Fig. 6). The family Oeeonesidae was plaeed together with Limnephilidae, Lepidostomatidae and others under the superfamily Limnephiloidea, infra-order Plenitentoria. This infra-order is eharaeteried by larvae with prosternal horn, and adults with tentorium eomplete. Diffieulties in this arrangement arise from the fact that larvae of several oeeonesids—the New Zealand *Zelandopsyche ingens* Tillyard (Cowley 1978) and the Tasmanian *Tascuna ignota*—do not have the prosternal horn.

The complete tentorium in adults, together with size and position of notal selerites, prosternal horn in larvae and short anal proeesses in pupae, places Pleetrotarsidae in Weaver and Morse's (1986) dendrogram with Limnephilidae and Lepidostomatidae rather than besides Philorheithridae.

The eurved pupal mandibles, presenee of anterior hook plates on segments 2 and 8, and eoiled labrum,


Gravenhorstii
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clearly separate *Plectrotarsus* from all other families. The synonymy with Kokiriidae, as proposed by Weaver (1984), is rejected on the basis of differences between the development of tentorium, as well as structural differences in larval and pupal morphology as described by Cowley (1976, 1978). Of the Kokiriidae, Ross (1967) commented ". . . the entire set of mouth parts similar to but part by part apparently not homologous with the mouth parts of the Plectrotarsidae". Comparisons show the only visible difference is the presence of rudimentary mandibles (Fig. 4) in Plectrotarsidae, which apparently are absent in Kokiriidae.

Extended mouth parts are known outside these two families (Crichton 1957), but their function has not been fully examined and compared. Adults of Plectrotarsidae are frequently collected on flowering shrubs such as *Leptospermum* sp. and *Melaleuca* sp. and although they have not been observed feeding upon the flowers, such mouth parts could be adapted for nectar feeding. New figures of the adult head are given (Figs 4, 5) to highlight unusual features and for comparison the lateral aspects of kokiriid (Fig. 6), oeconesid (Fig. 7) and lepidostomatid (Fig. 8) heads showing the position and shape of tentorial branches. Copulation takes place during daytime when pairs, with heads in opposing directions (Fig. 29), are seen sitting on vertical stems of sedges (Cypraceae) and grasses. The larvae inhabit shallow, vegetation-rich lakes, backwaters of small streams and swamplands. They are detrivores, feeding on pieces of decomposing vascular plant tissue, as confirmed by microscopic examination of ingested gut contents.

Fig. 29—*Plectrotarsus gravenhorsti* mating pair; upper specimen—male, lower specimen—female. *Photo: A. Neboiss.*

DESCRIPTIONS

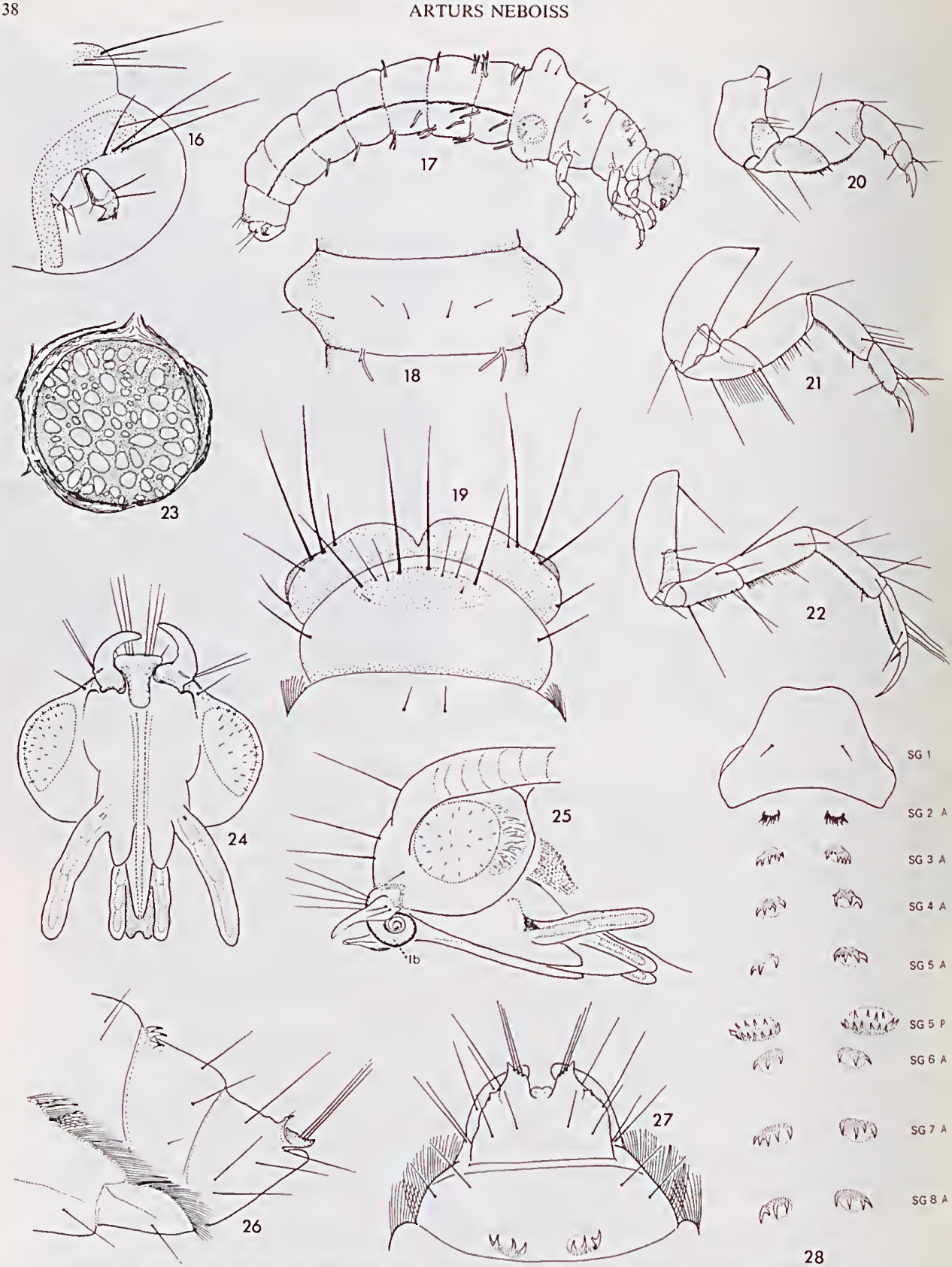
LARVA: (Figs 9-12, 16-22). Length up to 15 mm (mature larva). Head only slightly longer than wide, sides evenly rounded (Fig. 9); colour light reddish brown, muscle scars small, numerous, rather inconspicuous; pale, more or less distinct band on each side extends from eye to posterior of head; pale elongate spots occur near the constriction of frontoclypeal apotome and on either side of the beginning of coronal suture; antennae small, midway between eye and anterolateral margin of head capsule; setal positions as illustrated; anterior margin of frontoclypeal apotome straight. Labrum incised mesally, three very small setae on each side close to anterior margin. Mandibles short, robust, cutting edge with short, irregular teeth, without mesal brush of hairs. Ventral apotome (Fig. 10) short and broad, lateral margins distinctly convex, completely separating genae.

Pronotum strongly sclerotised, short, with transverse elliptic bulge on each side, almost meeting mesally (Fig. 12); similar in shape to pronotum of Tasmanian (Fig. 13) and New Zealand oeconesid larvae; colour in live specimens dark, blackish brown fading to reddish brown in preserved material, posterior margin dark brown, setae along anterior margin only; prosternum, including prosternal horn, membranous, pale. Meso- and metanota each with three pairs of small, slightly sclerotized plates at setal areas 1, 2 and 3.

Forelegs rather short (Fig. 20) trochanter and femur with row of short, pale setae, tibia with apical spur. Mid- and hind legs (Figs 21, 22) more elongate with numerous setae; claws all similar, slender, curved, each with a strong basal spine.

Abdomen pale cream or yellowish, gills present on segments 1-7 (occasionally to 6), consisting of single, double or triple filaments arranged as in Fig. 30. Lateral line of short, fine filaments on segments 2 to 8, bifid processes on segment 8 absent. Abdominal segment 1 with dorsal and lateral spacing humps, each lateral hump with a pair of small bristles and sometimes with a minute circular sclerite; sternum with three pairs of fine bristles; tergite

Figs 1-15–1-5—*Plectrotarsus gravenhorsti*: 1, type specimen labels; 2, type specimen head lateral, after Ulmer (1904); 3, type specimen head ventral, after Ulmer (1904); 4, head ventral, cleared specimen, md—mandible, lb—labrum; 5, head lateral, showing position of tentorium; 6, *Taskiria austera*, Kokiriidae, head lateral. 7, *Tascuna ignota*, Oeconesidae, head lateral. 8, *Goerodes* sp. Lepidostomatidae, head lateral, (loc. Sulawesi). 9-12, *Plectrotarsus gravenhorsti* larva: 9, head anterior; 10, head posterior and dissected mandible; 11, head lateral; 12, thoracic segments dorsal. 13-15, *Tascuna ignota* larva: 13, head and thoracic segments dorsal; 14, head anterior; 15, head posterior.



Figs 16-28–*Plectrotarsus gravenhorsti* larva and pupa: 16, anal proleg, lateral; 17, larva, lateral; 18, abdominal segment 1, ventral; 19, last abdominal segments, dorsal; 20, foreleg, lateral; 21, midleg, lateral; 22, hindleg, lateral; 23, pupal chamber, anterior closing membrane; 24, pupal head, ventral; 25, pupal head, lateral lb— labrum; 26, pupa, last abdominal segments, lateral; 27, last abdominal segments, dorsal; 28, hook plates, with abdominal segment (SG) number and anterior (A) or posterior (P) position indication.

	2-3 2-3	1-3 1-3	0-1 0-2	0-1			
1-3	1 1-2 2-3	1 1-2 2-3	1 1-3	0-1 1-2	1-2	1	
1	2	3	4	5	6	7	8

Fig. 30—*Plectrotarsus gravenhorsti*, schematic gill diagram of lateral aspect of larval abdomen showing segment number and number of filaments in each position.

8 with two pairs of small and a pair of larger, mesal bristles on posterior margin, dorsal plate on tergite 9 present, but usually rather indistinct; anal prolegs (Fig. 16) with two or three accessory hooks.

Before pupation the larva enters benthic sediments, attaches the anterior end of the case to roots or some coarse material and seals both ends of the case internally with finely and irregularly perforated membrane (Fig. 23).

PUPA: (Figs. 24-28). Length (male) to 12 mm; width 2.8 mm. Mandibles strongly and evenly curved, broad based, inner margins finely serrate, a pair of bristles of about equal length at the base; mouth parts (Fig. 24) extended, adpressed to the body on ventral side; labrum subquadrate with 3 pairs of long and one pair of short black bristles, anterior margin straight, but inner surface is developed into a free coil (Fig. 25). It appears that this part becomes extended at emergence and remains in front of the elongated mouth parts. Antennae stout, extend to abdominal segment 6; a pair of setae situated between the eyes and base of mandibles; two pairs on frons between eyes and one pair on top of head between antennal bases. *Legs*: Tarsi of meso- and metathoracic legs surrounded by rather thin, long scattered hairs; they are not present on prothoracic legs.

Abdomen pale creamy-white, abdominal gills single or double filaments on segments 3 to 6; lateral pigment bars as thin lines on tergites and sternites; lateral fringe dense, but restricted to segments 6 to 8 only; anterior hook plates each with 3-5 hooks on segments 2 to 8 (Fig. 28) posterior hook plates on segment 5 only with hooks in two irregular rows; segment 1 dorsally with a pair of fine setae, dorsomesal section elevated, but not sclerotized; segment 9 with two pairs of rather long dorsal setae; anal process short (Figs 26, 27) with a short preapical, dorsally situated horn and three, about equally strong, setae at the mesal margin of apical angle; each side with four ventro-lateral setae.

CASE: Length to 18 mm, width 5 mm (Fig. 31). Constructed of irregular elongate fragments of plant material, arranged circumferentially with many loose ends giving untidy, shaggy appearance, roughly tubular, cross-section circular, only slightly tapered posteriorly, inner lining of silk minimal.

MATERIAL EXAMINED: VICTORIA: 2 larvae, Ballan, 9 Jul. 1954, A. Neboiss; 1 larva, Wilsons Promontory National Park, 8 Sept. 1953, G. W. Douglas; 1 pupa, same loc. 6 Nov. 1986, A. Neboiss; 28 larvae, same loc. 19 Aug. 1987, A. Neboiss and K. Walker. TASMANIA: 2 larvae, Blackmans Lagoon, 13 Jul. 1973, A. M. Richardson; 1 larva, Tower Hill Lagoon, 13 Jul. 1973, A. M. Richard-

Fig. 31—*Plectrotarsus gravenhorsti*, larva and case. *Photo: Museum of Victoria, Photography Department.*

son. All specimens in Museum of Victoria.

REMARKS: 12 specimens of similar larvae were taken from a trout stomach, caught at Bronte Lagoon, Tasmania, 28 Aug. 1971, R. B. These specimens differ from *Plectrotarsus gravenhorsti* by the almost unicolorous dark brown head; the pale lateral bands are absent. The locality is in the Central Province as defined by Neboiss (1977) in the main centre of distribution for *Plectrotarsus tasmanicus* Mosely and may well be the larvae of this species.

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